REMARKS

1. Summary of Final Office Action

In the Final Office Action mailed August 15, 2005, with claims 1-24 pending, the Examiner (i) rejected claims 1-2, 5, 9, 13-14, 17-18, and 21-24 under 35 U.S.C. § 102(e) as being anticipated by U.S. Patent 6,856,624 (Magret); (ii) rejected claims 3, 4, 6, 10, 11, and 19 under 35 U.S.C. § 103(a) as being unpatentable over the combination of Magret and U.S. Patent 6,466,964 (Leung); (iii) rejected claim 8 under 35 U.S.C. § 103(a) as being unpatentable over the combination of Magret and Farinacci, "RFC 2784 – Generic Routing Encapsulation (GRE)." (RFC 2784); (iv) rejected claims 7, 12, 15, 16, and 20 under 35 U.S.C. § 103(a) as being unpatentable over the combination of Magret and U.S. Patent Application 2002/0021681 A1 (Madour); and (v) indicated that the arguments made in Applicant's Response to the Office Action mailed January 11, 2005 have been considered but are now moot.

2. Summary of Advisory Action

On October 17, 2005, Applicant submitted a response to the 8/15/2005 Final Office Action, which prompted the Examiner to issue an Advisory Action, which was mailed on January 10, 2006. In that Advisory Action, indicated that the amendments made by Applicant in the 10/17/2005 response would not be entered because, in the Examiner's eyes, those amendments were "not deemed to place the application in better form for appeal by materially reducing or simplifying the issues for appeal."

3. Status of the Claims

Claims 1, 5, 7-13, 15-17, and 21-24 are currently pending, of which claims 1, 5, 9, 13, 17, and 21-24 are independent. Claims 2-4, 6, 14, and 18-20 have been canceled. In this Response,

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Applicants have amended claims 1, 5, 7, 9-11, 13, 16, 17, and 21-24. This includes amendments not yet entered by the Examiner, as well as some additional amendments. As such, all pending claims remain rejected on the grounds indicated by the 8/15/2005 Final Office Action, and the status of the claims, prior to this response, is as it was prior to that Final Office Action.

4. Summary of the Claimed Invention

The claims are directed in various ways to methods and systems for establishing connections with mobile nodes. According to the claimed invention, an entity having Mobile IP foreign-agent functionality (a foreign agent) receives a registration request from a mobile node that is seeking to engage in Mobile IP packet-data communication via that foreign agent. The foreign agent then assigns a tunnel identifier for use in facilitating the Mobile-IP communication for that mobile node. This tunnel identifier may be just a simple integer value.

The foreign agent maintains two tables: a tunnel table and a connection table. The tunnel table is indexed by tunnel identifiers, and each entry in that table essentially contains a pointer or reference to an entry in the connection table. The entry in the connection table is where the foreign agent stores connection information, such as point-to-point protocol (PPP) information, related to the mobile node.

The foreign agent then tunnels this registration request to the mobile node's home agent. Before doing so, the foreign agent inserts the assigned tunnel identifier into a key field in a tunnel header that the foreign agent uses to tunnel the registration request to the home agent. When the foreign agent receives a registration reply tunneled from the home agent, that reply also has that tunnel identifier in a key field in the tunnel header. The home agent has also stored this tunnel identifier for use in the ensuing packet-data communication in which the mobile node will engage. Upon receipt of this registration reply from the home agent, the foreign agent

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removes the tunnel header, thereby removing the tunnel identifier, from the registration reply, and forwards the registration reply to the mobile node.

Thereafter, when the foreign agent receives packets tunneled from the home agent for the mobile node, those packets will be encapsulated in a tunnel header having the tunnel identifier in a key field. Thus, both to send the registration reply and these ensuing packets to the mobile node, the foreign agent will remove that tunnel header, again thereby removing the tunnel identifier from the packets, and use the tunnel identifier to identify the connection to the mobile node. The foreign agent does so by using the tunnel identifier to identify an entry in the tunnel table. Recall that the tunnel table is indexed by tunnel identifiers, so this step is more akin to a direct lookup into an array than it is to a process of searching for an entry in a visitor table, list, or cache that has one or more values that match a value (or values) found in an inbound packet.

The foreign agent then uses the identified entry in the tunnel table to identify an entry in the connection table. Again, this entry in the connection table has connection information related to the mobile node. The foreign agent then forwards the packet to the mobile node using this identified connection information.

Note that, according to the present invention, no adaptation or special implementation of any functionality is necessary on the part of the mobile node. As far as the mobile node is concerned, it sends standard Mobile-IP registration requests, receives standard Mobile-IP registration replies, sends standard Mobile-IP outbound packets, and receives standard Mobile-IP inbound packets. With the benefit of the present invention, the replies and inbound packets may arrive more quickly than they otherwise would, due to the fast lookup by the foreign agent.

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5. The Prior Art

a. Magret

The underlying problem that Magret attempts to address is the handling of the situation in which two mobile nodes having identical home addresses seek to register with a foreign agent and engage in Mobile-IP communication via that foreign agent. This may occur where both mobile nodes have private IP addresses for home addresses on their respective networks.

Magret handles this problem by assigning the later-registering mobile node a temporary IP address for use with respect to that foreign agent. As explained more fully below, Magret teaches the use of an additional IP packet encapsulation, complete with an additional temporary IP network address, to uniquely identify a mobile node. This additional temporary IP address is used to identify received packets intended for the mobile node. Thus, Magret teaches an extra layer of tunneling between the home agent and the mobile node.

i. Registration

Magret teaches that that second mobile node would send a first registration request to the home agent, where that first registration request includes the second mobile node's "true" home address. See Magret, Figure 7 and column 9, line 45 to column 10, line 6. The foreign agent sends the mobile node a registration reply that rejects the request and provides a temporary IP address for the mobile node to use. See Magret, Figure 8 and column 10, lines 7 to 44. The mobile node then sends a second registration reply that includes this temporary address. See Magret, Figure 7 and column 9, line 45 to column 10, line 6.

The foreign agent then forwards this second request to the mobile node's home agent. See Magret, Figure 8 and column 10, lines 7 to 44. The home agent then associates the mobile node's home address with that temporary address and with the foreign agent's address. See

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Magret, Figure 9 and column 10, lines 46 to 11, 16. The home agent then transmits a registration reply to the foreign agent. See Id. The foreign agent then makes an entry in its visitor cache that includes, among other values, the mobile node's temporary address, home address, home-agent address, and link-layer source address. See Magret, Figure 8 and column 10, lines 7 to 44. Finally, the foreign agent sends the registration request on to the mobile node. See Id.

ii. Routing Packets Inbound to the Mobile Node Using the Additional Packet Header

With respect to packets inbound to the mobile node (having a destination address equal to the mobile node's true home address), Magret teaches that the home agent encapsulates those packets in an IP header addressed to the temporary address, encapsulates them a second time in an IP header addressed to the foreign agent, and sends them to the foreign agent. See Magret, Figure 10A, column 11, lines 18 to 49.

The foreign agent then removes the first IP header and uses the next one to identify – based on the temporary address – that the packet is intended for the mobile node. See Magret, Figure 10B, column 11, lines 50 to 55. Thus, Magret teaches that the foreign agent would search its visitor cache for an entry containing the temporary address, and then route the packet to the mobile node using the data-link layer source address contained in that visitor cache entry.

Upon receipt of the still-once-encapsulated packet, the mobile node must recognize that the packet has a first header addressed to its temporary address encapsulating an inner packet addressed to its home address. See Magret, Figure 10C, column 11, lines 56 to 59. The mobile node must then remove that encapsulating header to process the inner packet. See Id.

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iii. Routing Packets Outbound from the Mobile Node Using the Additional Packet Header

With respect to packets outbound from the mobile node, Magret teaches that the mobile node will encapsulate the outbound packets (having a source address equal to the mobile node's true home address) in an additional IP packet having a source address equal to the mobile node's temporary address. See Magret, Figure 11A and column 11, lines 60 to 67. The foreign agent will then use that temporary address to identify the home agent, and tunnel the already-encapsulated packet in yet another IP packet having a source address equal to the foreign agent's address and a destination address equal to the home agent's address. See Magret, Figure 11B and column 12, lines 1 to 13.

Outbound traffic from the mobile node would thus be encapsulated once by the mobile node in a header having a source address equal to the assigned temporary address and encapsulated a second time by the foreign agent in a header having a source address equal to the foreign agent's address and a destination address equal to the home agent's address. See Id. The home agent then must remove the header addressed from the temporary address prior to processing the packet addressed from the mobile node's true home address. See Magret, Figure 11C, column 12, lines 14 to 19.

b. Leung

Leung is designed to handle a different problem: providing Mobile-IP functionality to mobile nodes that do not themselves support Mobile IP. See Leung, Abstract. Leung addresses this problem by having a foreign agent send registration requests to home agents and receive registration replies from home agents on behalf of the mobile nodes, thus performing proxy Mobile-IP registration on behalf of the mobile nodes. See Id.

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Since the mobile nodes never see the registration requests or replies, they are arranged to transmit outbound packets to a dummy IP address. See Magret, Figure 7A and column 13, line 53 to column 14, line 7. That dummy IP address is recognized by each foreign agent with which the mobile node may come into contact. See Id. The mobile nodes are thus arranged to maintain a mapping between that dummy IP address and the MAC address of the foreign agent to which the mobile node is currently attached. See Magret, Figure 7B and column 14, lines 8 to 46.

With respect to routing inbound packets to mobile nodes, Leung contains no advance beyond the standard Mobile-IP practice of uniquely identifying a mobile node using a combination of the mobile node's home address and home-agent address.

6. Response to Examiner's Rejections

Each of the independent claims currently stands rejected as being anticipated by Magret. Furthermore, the Examiner gave indications in the 1/10/2006 Advisory Action that the amendments made by Applicant in the 10/17/2005 response to the 8/15/2005 Final Office Action, though not entered by the Examiner, would be unpatentable over the combination of Magret and Leung.

As amended herein, each independent claim includes the following elements: (i) receiving a registration request from a mobile node; (ii) determining or assigning a tunnel identifier; (iii) sending the registration request to a home agent, where that registration request includes the tunnel identifier in a key field of a tunnel header; (iv) receiving packets from the home agent that have the tunnel identifier in a key field of a tunnel header; (v) using the tunnel identifier from the packets to identify a connection to the mobile node; and (vi) sending the packets on to the mobile node over that connection.

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Furthermore, with respect to using the tunnel identifier from the packets to identify the connection to the mobile node, each of the independent claims includes using that tunnel identifier to identify an entry in a tunnel table that is indexed by tunnel identifiers, and then using that identified entry to identify an entry in a connection table, where the entry in the connection table comprises connection information (such as a PPP or other data-link-layer connection information) between the foreign agent and the mobile node.

The prior art simply does not teach this approach. As explained above, Magret teaches the use of an extra layer of tunneling between the home agent and the mobile node. This extra layer of tunneling uses the temporary IP address that Magret's foreign agent assigns to a second mobile node that attempts to register an already-registered home address. Magret contains no teaching that this temporary IP address would be inserted by a foreign agent into a key field of a tunnel header when the foreign agent tunnels outbound packets to the mobile node's home agent.

Furthermore, Magret contains no teaching that inbound packets from the home agent would have this tunnel identifier in a key field of a tunnel header; nor does Magret teach that the foreign agent would use this tunnel identifier to identify an entry in a tunnel table that is indexed by tunnel identifiers, and then use that tunnel-table entry to identify an entry in a connection table, where that connection-table entry has the connection information.

While the present invention involves a fast lookup using the tunnel identifier to directly access the tunnel table, which is indexed by tunnel identifiers, Magret teaches an approach that involves the extra overhead of an additional tunnel header, coupled with the necessity to search the visitor cache for an entry having a value that matches the temporary IP address in that extra tunnel header. Due to that extra header, Magret's approach results in more headers and less user data for a given packet size.

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Furthermore, Magret's approach involves the time and effort to add or remove this extra header at the ends of the tunnel. Finally, Magret requires implementation of the functionality on the mobile node related to (i) sending a second registration request using the suggested temporary address; (ii) encapsulating outbound traffic using this extra tunnel header; and (iii) decapsulating inbound traffic to remove this extra tunnel header. Magret thus does not anticipate the direct-table-access approach of the present invention.

Similar to Magret, Leung contains no teaching related to a foreign agent including a tunnel identifier in a registration request when sending that request to the home agent. Nor does Leung teach that such a tunnel identifier would be included in a key field of a tunnel header of incoming packets, or that the foreign agent would use that tunnel identifier to identify a connection to a mobile node. Leung does not teach this approach; rather, Leung is focused on foreign agents conducting registration on behalf of mobile nodes that do not support Mobile IP.

As stated above, with respect to routing inbound traffic to mobile nodes, Leung contains no teaching that goes beyond the standard Mobile-IP practice of maintaining a visitor list and searching that visitor list for a matching combination of home address and home-agent address. Leung gives no indication that the tunnel interface in Leung's Figure 6 is anything other than a reference number that is internally used by the foreign agent for data-structure management.

Leung certainly does not teach that the tunnel value 614 of Figure 6 is included in a key field of a tunnel header of packets that arrive from the home agent, and that the foreign agent then uses that number to identify the connection to the mobile node. Again, there is no indication in Leung that that value is anything other than a reference number that the foreign agent uses as shorthand for the home-address/home-agent-address combination that the foreign agent actually uses to identify connections to mobile nodes.

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7. Conclusion

Accordingly, Applicant respectfully submits that Magret does not anticipate any of the independent claims as amended. Furthermore, Leung does nothing to make up for Magret's deficiencies. Thus, the independent claims are not anticipated by Magret and are patentable over the combination of Magret and Leung, and are therefore allowable. Furthermore, the dependent claims are allowable for at least the reason that they depend from an independent claim.

Applicant respectfully submits that the amendments and remarks in this Response fully address the Examiner's rejections – both under § 102 and § 103 – with respect to all of the currently-pending claims. Furthermore, Applicant affirmatively states that it does not concede the merits of any of the Examiner's rejections, whether specifically addressed herein or not.

Applicant therefore submits that all of the pending claims are now in condition for allowance. Therefore, Applicant respectfully requests favorable action. Should the Examiner have any questions, the Examiner is encouraged to contact the undersigned at 312-913-0001.

Respectfully submitted,

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